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AUTHOR Albright, Michael J.
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ABSTRACT

Lack of effort is a major reason for non-success among students in remedial mathematics, and the presence of a reward or an incentive may increase motivation in this learner group. A survey investigated the attitudes of 421 students toward incentive options in a competency-based remedial algebra course at Iowa State University. Students rated the following incentives according to a seven-point Likert-type scale and a paired comparison questionnaire: awarding of course credit to count toward graduation; awarding of course credit not to count toward graduation; preference during course registration; release from required class attendance; opportunity to serve as tutor; posting of names of those who achieve high module scores; verbal praise from the instructor; reporting of module success to advisor; reporting of module success to parents; and no reward. Course credit to count toward graduation received an overwhelmingly favorable reaction. Only two other incentives received favorable responses: "preference during course registration" and "release from required class attendance." Results indicate that few of the rewards consistent with a competency-based system may be effective with students in remedial mathematics. Fourteen references are listed. (Author/LMM)

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Student Incentive Preferences in a Competency-Based Remedial Algebra Course

Michael J. Albright
Coordinator for Instructional Development
Media Resources Center
Iowa State University
Ames, Iowa 50011

April, 1984

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Abstract

"Lack of effort" is a major reason for non-success among students in remedial mathematics. It has been theorized that the presence of a reward, or incentive, may increase motivation in this learner group. The present study was designed to survey student attitudes toward incentive options in a competency-based remedial algebra course. Four hundred twenty-one students completed a two-part survey form. "Course credit to count toward graduation" received an overwhelmingly favorable reaction. Of the ten incentives surveyed, only two others received favorable responses: "preference during course registration" and "release from required class attendance." The others were not considered viable incentive options.

Student Incentive Preferences in a

Competency-Based Remedial Algebra Course

Sparking student interest in learning is a prime concern of instructors and administrators of remedial mathematics programs in post-secondary education. According to a survey of remedial service administrators at two-year colleges, "lack of effort" was considered the major obstacle to learning among low-achieving students, while "low intelligence" was rated the least likely reason for non-success among seven possible causes (Cross, 1971). Motivation is a particularly important factor among "high risk" students whose backgrounds often require careful reconstruction of learning patterns (Greising, 1969).

The recent proliferation of remedial programs has brought vast numbers of disinterested, unmotivated students to college mathematics departments. Over 75 percent of all four-year institutions and 95 percent of all community colleges now have some kind of preparatory math program (Lindberg, 1977). In fact, Steen (1978) notes that "the fastest growing subject in freshman college mathematics is grade school arithmetic."

Kerr and Lang (1981) classify remedial algebra students into four general categories:

1. A-level students who are active, self-motivated, and successful;
2. students who are passive, unmotivated, disaffected in class, and unwilling to do any more work than necessary, but are able to pass at a minimal level;
3. active, motivated students who attempt to learn but do not achieve success because of math anxiety or other factors; and

4. passive, unmotivated, indifferent students who make little effort and do not succeed.

According to Kerr and Lang, groups 1 and 3 put forth a sincere attempt to learn the material, while groups 2 and 4 have the capability to learn but are not compelled to try. These are the students for whom incentives may be necessary to motivate them to reach their learning potential.

Although the concept that performance can be improved by increasing motivation is not universally accepted (Klingelhofer & Hollander, 1972), a tenet of expectancy theory states that students can be inspired to increase their effort if a reward is likely to follow successful task performance (Slavin, 1977). Moreover, studies by Atkinson (1958) suggest that the more attractive the reward, the more vigorous an effort is likely to be expended by the learner. Greising (1969) points out that the need for immediate rewards, as opposed to the long-range incentive of degree achievement, is much more acute for high risk learners.

The purpose of a reward is to restructure the student's environment so that achievement of educational goals is more compelling. The literature on incentives seems to confirm that the use of appropriate rewards may indeed have a significant effect on learning (Lipe & Jung, 1971).

The incentive options available for use by college faculty members appear to have received little attention from researchers. Bebeau, Eubanks, and Sullivan (1977) tested preferences for 10 incentives commonly offered in college courses, using the paired comparison method with psychology students. "Release from final exam" was the overwhelming favorite, followed by "points

toward class grade." "No reward" and "assisting the instructor as proctor" were the least preferred. Bebeau and Sullivan (1982) then replicated the study with upper-division education majors and obtained nearly identical results. "Release from final exam" was again the most preferred option, with "positive comments from instructor" ranked second.

Several of the incentives tested by Bebeau and her colleagues, including the two most highly preferred in the 1977 study, are not appropriate in a competency-based program, where advancement depends upon achievement of specific criteria. The present study was designed to examine student preferences for rewards that are consistent with the competency-based approach.

Method

Subjects

Subjects were 421 students enrolled in a remedial algebra course at Iowa State University. In an attempt to facilitate student progress and improve quality control, the course was converted in 1982 to a modular, competency-based format with individual module prescriptions for each student determined by performance on a diagnostic test.

Instruments

Incentives included in the survey were carefully screened to meet two criteria. First, each incentive must be under the direct control of the

instructor, department, or university, rather than under the control of the student. For example, "personal expectations," which is a powerful motivator for students with high levels of achievement motivation, cannot easily be manipulated by the instructor and therefore is impractical as an extrinsic reward. Second, the incentive must be performance-contingent. In the case of a competency-based course, it must be available to all students who meet the required criterion levels and not available to those who do not.

Three of the ten incentives examined by Bebeau and Sullivan (1982) were considered appropriate for this study: "release from required class attendance," "verbal praise from the instructor," and "no reward at all." Those deleted included "course-related field trips," "discussion with authority," and "recognition in publications," which did not seem suitable for a remedial mathematics course.

Course credit is an important issue that the investigators felt should be on the list. Many institutions, including Iowa State University, do not award academic credit for remedial mathematics courses.

The list of incentives selected were reviewed and validated by colleagues of the investigator. Included were:

1. Awarding of course credit to count toward graduation.
2. Awarding of course credit <u>not</u> to count toward graduation.
3. Preference during course registration.
4. Release from required class attendance.
5. Opportunity to serve as tutor.
6. Posting of names of those who achieve high module scores.

7. Verbal praise from the instructor.
8. Reporting of module success to advisor.
9. Reporting of module success to parents.
10. No reward at all.

The survey instrument took the form of a two-part incentive preference scale. Part I was based on Atkinson's (1958) theory that the rewards perceived to be the most attractive to students are likely to be the most effective as incentives. Therefore, subjects were asked to rate each incentive independently on a seven-point, Likert-type scale with "very desirable" at one extreme and "very undesirable" at the other.

Part II employed the paired comparison method described by Edwards (1957). Each option was paired with every other incentive to form a list of 45 pairs. The presentation sequence was selected at random. Students were asked to consider each incentive in each pair and mark the one they perceived to be the more desirable.

Procedure

The survey was administered during the first fifteen minutes of a regularly scheduled class period in the fifth week of fall semester classes. All sixteen sections of the course participated.

Subjects were given the questionnaire in printed format. Instructions were typed at the beginning of each part and also were provided orally. Complete anonymity was guaranteed.

Results

Paired Comparisons

The paired comparison data were analyzed by tabulating the ten incentives in rows and columns. Percentages were entered by column to indicate the proportion of student preference for that incentive over the incentive listed in each row (Edwards, 1957). The results appear in Table 1.

Insert Table 1 about here

"Course credit to count toward graduation" was the overwhelming choice as most desirable incentive. Ninety-one percent of the students preferred graduation credit over all other options. "Preference during course registration" and "release from required class attendance" were also preferred by large majorities over other incentive options. In the rank ordering, "no reward at all" finished last, barely behind a reward receiving surprisingly little support, "course credit not to count toward graduation."

The percentages for each column were summed and converted to scale values reflecting deviation units above the least preferred option, according to the Case V Model of Edwards (1957). This procedure presents an accurate perspective of student preference for each incentive in comparison with the

other alternatives. The degree of preference for "course credit to count toward graduation" was illustrated by its scale value, 2.178, more than two deviation units above the least preferred choice. Scale values of 1.567 and 1.162 were calculated for "preference during course registration" and "release from required class attendance," respectively. None of the other seven rewards had scale values more than one deviation unit above the lowest ranked option.

The validity of the results is dependent upon the consistency of subject responses. According to logic, if Option 1 is preferred over Option 2 and Option 2 over Option 3, then Option 1 should also be favored over Option 3. If Option 3 is preferred over Option 1, the result is what Kendall (1948) describes as a circular triad, an inconsistency. Ideally, the number of circular triads in any set of paired comparison responses should be minimized.

Kendall developed a formula for the coefficient of consistency (zeta) that incorporates the number of circular triads and provides a measure of within-subject consistency of ratings (Edwards, 1957). The zeta value is determined individually for each subject and evaluated according to the k^2 distribution. It can be calculated from Kendall's formula that with ten stimuli being compared (df = 20), a zeta score of approximately .45 is required for statistical significance at the .05 level and .57 for significance at the .01 level. Zeta scores of .45 or higher were obtained for 98 percent of the subjects, and 96 percent achieved zeta scores of .57 or higher. In fact, 72 percent had zeta scores of .90 or higher, indicating an extremely high rate of consistency.

Since subjects may be perfectly consistent in their responses yet not agree with each other, Kendall also developed a statistic designated u, the

coefficient of agreement (Edwards, 1957). A value of 1 is obtained when there is perfect agreement among the judges. The minimum possible value of u is a function of the number of judges but can never be less than -1. Any positive value of u indicates some degree of agreement. The coefficient of agreement obtained was .3438. Using Kendall's test of significance for u, which is also tested against the χ^2 distribution, a χ^2 value of 6574.01 was obtained, df = 45, $p < .001$, confirming a highly significant degree of agreement among raters.

Attitude Scale

While the calculation of scale values according to Edwards' Case V Model is one means of determining the strength of subject feelings toward any one option, another technique is the evaluation of each stimulus independently using a Likert-type rating scale. The results of part I of the questionnaire may be found in Table 2. The rank order obtained using this method was nearly identical to that indicated in Table 1, with only the seventh and eighth choices reversed.

Insert Table 2 about here

Table 2 also provides the percentage of subjects responding favorably (1-3), indifferently (4), and unfavorably (5-7) to each item. The enthusiasm for "course credit to count toward graduation" is confirmed by Table 2. Ninety-three percent of the subjects responded positively to this incentive,

and the mean score of 1.71 indicated that the majority of responses were highly positive.

"Preference during course registration" was again a clear-cut second choice, with 67 percent in favor and just 13 percent considering it undesirable. Only one other incentive listed was deemed desirable by as many as 40 percent of the subjects. Nearly twice as many favored "release from required class attendance" as opposed it, 53 percent to 27 percent, but the mean score of 3.57 indicated few extremely positive ratings and only moderate interest overall.

A Pearson product-moment correlation was calculated to determine the degree of consistency between the scale values from the paired comparisons and the mean rating scores from the seven-point attitude scale. The resulting r of .98 ($p < .001$) confirmed that subjects marked both parts of the questionnaire consistently.

Discussion

If it is true that high risk students need a reward structure to increase their incentive to learn (Greising, 1969) and that the more desirable the reward, the stronger its incentive value (Atkinson, 1958), it appears that few of the rewards consistent with a competency-based system may be effective with students in remedial mathematics. Only three of the potential rewards evaluated in this study aroused much student interest.

It should not be surprising that course credit counting toward graduation was held in such high regard. The course at Iowa State University requires

just as much time and effort as freshman-level courses. Mathematics departments typically resist offering academic credit for remedial algebra because incoming students are expected to have learned this material in high school. However, Cross (1976) feels that degree credit should be granted for remedial courses. She points out that the students most in need of remediation are those who have found little meaning and satisfaction in learning. For them to complete successfully what may be (for them) a demanding course only to be denied academic credit may reinforce the hollow feeling they have about education. Cross notes that credit is the most significant immediate and tangible reward that colleges and universities have to offer.

Response to "course credit not to count toward graduation" was unexpected. It had been hypothesized that graduation credit would be highly regarded but that academic credit of any kind would be a viable incentive. Two participating classes were given informal post-hoc interviews to solicit their rationale for responding as they did. Students resented having to take courses that did not count toward their graduation requirements, regardless of whether academic credit was offered. Moreover, they did not want non-degree credit courses to influence their grade-point averages.

"Preference during course registration" appears to be an incentive that rates serious consideration. Competition for seats in high-demand courses is keen at many institutions, and large numbers of students, particularly underclassmen, are often "closed out." The possibility of obtaining "head of the line" privileges at preregistration if a remedial course is completed successfully may be a powerful incentive. Since a competency-based system often increases the number of incomplete grades awarded, registrars may be

willing to grant registration privileges in a trade for more passing grades and fewer incompletes to be processed.

Moderate support was given to "reporting of module success to advisors." Most students enrolled in the program are freshmen, many of them admitted conditionally because of low high school grades, and the idea of confirming their progress by sending notes to their advisors may have been appealing to this group. However, this incentive had the highest percentage of "no opinion" responses. (See Table 2.)

While "verbal praise from the instructor" received the fourth highest percentage of positive responses on the seven-point scale (see Table 2), the mean score of 4.03 was considerably lower than that obtained for the same incentive by Bebeau, Edwards, and Sullivan (1977), 2.78, and Bebeau and Sullivan (1982), 2.69. The differences may well have been a function of the courses in which the data were collected and the attitudes of the students surveyed. It supported Cross's (1976) belief that tangible rewards seem to be more effective for students in remedial courses.

The results of this study provide additional insight into the incentive preferences of students enrolled in a remedial mathematics program. The key issue yet to be resolved is whether implementation of a system using an incentive program would actually have a positive effect in improving student performance.

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Table 1

Student Preferences for Incentives

When Presented in Pairs, by Percent

	Scale Value	1	2	3	4	5	6	7	8	9	10
1. Course credit -- counts toward graduation	2.178	--	08	14	17	07	06	04	10	06	06
2. Course credit -- not to count toward graduation	0.137	92	--	86	75	68	68	62	75	69	55
3. Preference during pre-registration	1.567	86	14	--	43	17	10	15	17	11	07
4. Release from required class attendance	1.162	83	25	57	--	27	25	27	33	28	15
5. Opportunity to serve as tutor	0.420	93	32	83	73	--	56	55	60	55	37
6. Posting of name of high scorers	0.460	94	32	90	75	44	--	51	67	51	29
7. Verbal praise from instructor	0.513	96	38	85	73	35	49	--	64	51	24
8. Reporting of scores to advisors	0.787	90	25	83	67	40	33	36	--	42	19
9. Reporting of scores to parents	0.516	94	31	89	72	45	49	49	58	--	29
10. No reward at all	0.000	94	45	93	85	63	71	76	81	71	--
Mean percentage		91	28	76	64	38	41	43	52	42	25
Rank order		1	9	2	3	8	7	5	4	6	10

Table 2

Student Preferences for Incentives

Considered Independently, by Percent

Rank Order	Incentive	For	Indif	Against	$\bar{X}$
1	Course credit to count toward graduation	93	04	03	1.71
2	Preference during course registration	67	20	13	2.87
3	Release from required class attendance	53	20	27	3.57
4	Reporting of modules success to advisor	36	35	29	3.90
5	Verbal praise from instructor	39	28	33	4.03
6	Reporting of module success to parents	30	27	43	4.40
7	Posting of names of those with high scores	26	24	50	4.57
8	Opportunity to serve as tutor	24	23	53	4.66
9	Course credit not to count toward graduation	26	09	65	5.04
10	No reward at all	10	13	77	5.74